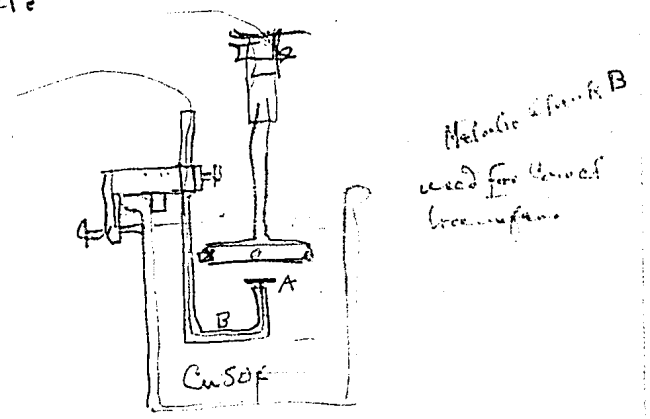
Notebook Series -- Notebooks by Edison
Notebook, N-12-08-09

This notebook was used by Edison during August 1912. The entries pertain to the electroplating, molding, and pressing processes involved in disc record manufacture. Included are notes and drawings on nineteen consecutively numbered experiments involving electrolytic deposits of copper and nickel. Also included are notes on a modified plating tank used to deposit gold and silver on intermediate "submaster" molds, as well as the details of further experiments on plating and pressing with various metal alloys and varnishes. Edison's notes indicate that H. Grimes, Sherwood T. (Sam) Moore, and Ludwig F. (Louis) Ott assisted with these experiments. The front cover is marked "Electro-Plating Experiments Aug, 1912." The pages are unnumbered. Approximately 35 pages have been used.

Aug 9 - 1912

Expts to get more even deposit of Nickel on the Copper faced Wheels & also to give even first Coat of Copper over the gold



Crack rotated 30 Revolutions minute
Anode Copper one inch diameter, insulated
all but the inch surface

1st Experiment.

Anode 1/2 inch below plate opposite center of plate B — One amp 2 minutes, only slightly blushed. little more in Center middle section not so much as edge

Aug 9 -

2nd Expt -
2 Minutes . 1 amp
most in center, edge for 1/2 inch some but not increased much, Nickel seen plain Except Center -

3rd Expt 2 minutes 1 amp

getting better, no covered yet on middle part when viewed by reflected light Can still see nickel

4th Expt
4 Minutes 1 amp

It is not yet covered in middle part It is mostly the Center that is Covered, the outside edge dont seem to increase The anode rod is somewhat Exposed where it is clamped & I think Considerable of the Cap at Edge Comes from that

Aug 9 — 1912.

as the center covers too fast we now lower the anode to one inch below the face of the metal disc — use tape the leaky place.

Expt 5

New plate
5 minutes 1 amp

Very good, center advanced very much more outward than in same time in previous Expts. Only little on Edges, middle portion partly covered — all viewed by reflected light —

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Expt 6

We now lower the anode to 1½ inch below face of the plate –
5 minutes 1 amp –

New plate –
This shows very much better –

Expt 7

We now lower anode to 2 inches below face of metallic disc & retaped the anode rod above the obly of rubber tubing

New plate
5 minutes 1 ampere
on 835- VII

This covered the best yet the couley was lighter than previously & extended 3/4 inch dia – the central point

was somewhat covered so it had copper luster by reflected light. Edge was covered more than 1/2 than central point, but taken as a whole its approaching near to what we want

Expt 8

Anode lowered to 2 1/2 inches below plate & holder retaped to stop leakage

We use new plate (10) cleaned plate,

5 minutes 1 amp

on 852 48 Rev Crock

JM This is better yet the most even

We are now going to make a big jump and lower anode 4 inches below plate

Aug 9 1912

Expt 9

Anode 4 inches below plate

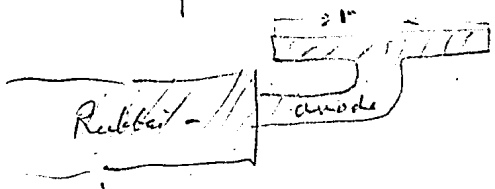
1 amp 5 minutes

910 on

This is practically Even all over leaves nothing to be desired, of course can see the nickel through it by direct + scarcely at all by scattered light = to cover it so nickel could not be seen would probably take 10 to 12 minutes.

We will no try if doubling the current and 1/2 the time produced same result -

Expt 10 –
anode 4 inches below plate
Center,
2 amperes for $2\frac{1}{2}$ minutes.
anode 4" inch away
Covers even & not the same as
in Expt No 9 = . it is a very high
density on anode –



Think there is $2\frac{1}{2}$" surface on
anode exposed to action of liquid

Expt 11 = anode 4" away
3 amp 1 min 42 sec
Expt spoiled only went 1 min 20 sec
Then drop to $1\frac{1}{2}$ @ 1 amp –
Covered Even —

Phenomenon Copper sticks better
harder to rub off – Velocity of ion
probably increased

This being the case and we will prove it it is better to plate the copper mould instead of 7/10 amp for 1 hour to plate it at 3 times the density 2·1. amp for 20 minutes

Expt 12 = anode 4" away

1/2 amp for 10 minutes to see if it adheres as well as in Expt No 11

on 941. of 951. off – dont stick so well

It is covered even but only 1/2 the amount apparently as in Expt 10 This shows too low density not good – possibly first part deposited gets wiped off by rotation of the liquid –

Note – in my Expt 13 the 3 amp holds for 3/4 min then current goes very down – Examined connection & also changed to 3 new cells but it does same thing = I suspect that as anode is small the density is too high & goes too much we need take it out & will try & increase area to twice what we have making 1½ dia instead of 1 inch

I noticed with increased density the tendency is to increase deposit a little more at the edge – the edge & center may be due to Eyes as in light plating Edge is on verge of covering entirely same way with Center, a little more copper at these points makes a vast dif in reflection of light hence it cannot be that very little perhaps all the Expts of heavier deposited would have shown this

Expt 13

Note change

We now put on another cell so we can get more than 3 amp if we want them —

Anode 3 away – 1½ diameter
3 amp for 3½ minutes

to see if fully covered by direct light – we know its evenly covered but want to see amount is enough to fully cover the Nickel – Current kept OK – it was the high density that made gas noted opposite page that caused gas + Current to go down 3 amp on 1½ dia anode is the limit – it should not go above 2 amp –

In this Experiment Center + Edge fully covered – Central portion has darkish tinge to Copper showing not perfectly Covered – by reflected light it appears perfectly covered

The only way edge can be got perfect is to put a choking guard near it —

14th Expt = We have plated a No 7 submaster with gold with 1 G gold wire 4 hours — this has a groove inside wound with several turns of fine relay wire finest we have, The plating is fine Moore is going to cover it up on the relay wire or below it not above so as not break the gold. —

We are putting the 1½ dia Copper anode 2" away from the golded submaster to allow for the Resistance of the gold film —

Using 1 amp at first for 10 minutes & then look at it,
Crack about 30 Rev min
12 36½ HH HH

Covered all over good, even
Notice a streak all way across
& one or 2 spots, may be water
left Cop & gave an illusion

Expt 15 - Continued 1 amp
on it 1248 on HH HH

Same streak is on it has very
sharp edge & straight look as
if Master NO7 had cracked
there are several other bad
spots or spots bare of Copper
dont seem get much thicker

Probably an current had to go thru the gold in this scheme it heated it + cracked it

Expt 16 —

We now put on 2 amp

10 minutes — 101½

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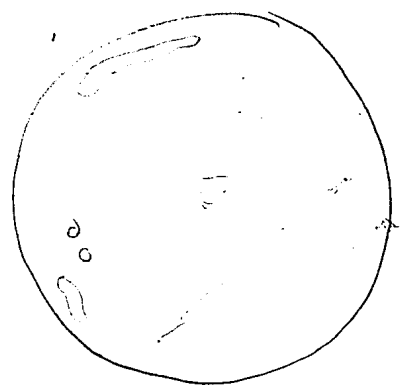


Spots like gold —

Lot round spots which dont seem to cover

It doesnt seem to be any more covered — Looks just like oil on surface both on 1st putting it in it clings the gold prevented current plating —

Expt 17 -

3 amp 10 minutes

1.17 - 1111 1 6 min 2 ½ amp

Something Caused it, anode & quick -

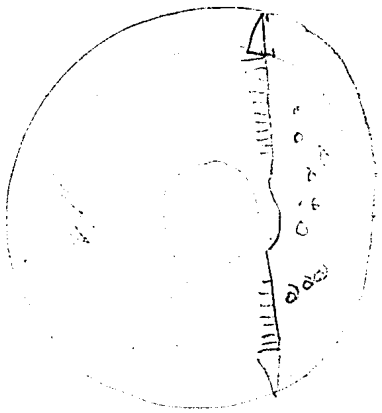
7 min 2 amp - 8 min - 2.2 amp

9 minutes 2.5 10 Min 2.7 -

off —

Its getting thicker, the spots are closing up the big crack or attack is a little less

The place where label is is darkish as of thousands of spots showed when placing to the black Mercury —



This shaped bare gold spot exactly duplicated at bottom.

It looks like oil on the water when he 1st dipped it touched the gold which the lines carried it forward where smooth part at center disappeared.

Expt 18

2 amp for 10 min more on 1,30½ HH HH

Covering more but not much, spots are almost as prominent. The bare spots are gold & apparently are coated over with something that prevents current from reaching surface etc. Certainly change what it is.

1,46. off 1,56 – off –

Covering more but whisker on the strait line is still gold & 1/8 long not covered & spots not covered

Expt 19

2 amp 10 min –

204 am –

The streak is gradually closing by creeping

It is due to oil on the surface of the electrolyte & in dipping it got one the gold & personally insulates the gold –

We found islands of insulant oil floating on the solution

The oil came from the tape we used to insulate a bad place on the anode.

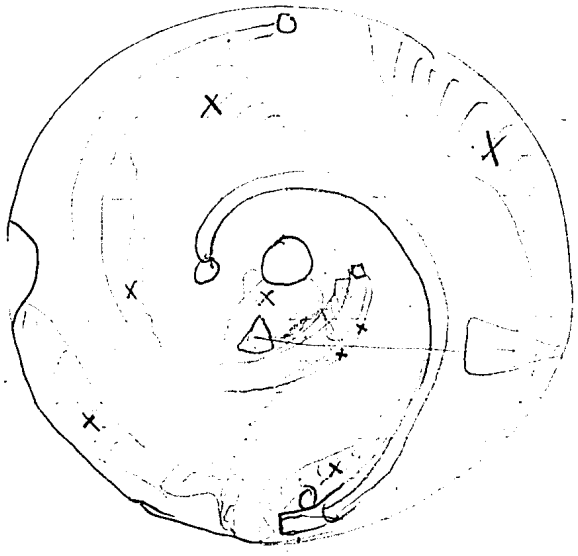
This proves that there must never be oil on the electrolyte and every effort should be made & every precaution used to prevent it

also the rotation of the crock should not exceed 15 Rev minutes until it is covered then it can be raised to 25 for 10 or 15 minutes,

We now put the record in the regular bath one hour at 5 amp for an hour — after that his regular 8 or 10 amp until we get a mould,

End of the Expt

X Move green here



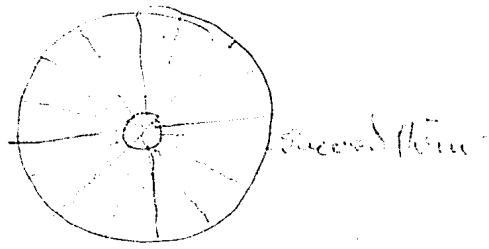
The ⬡ are heavy coated gold
plates & base tips are black.

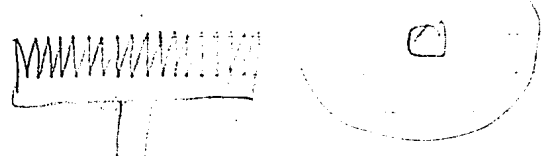
Gold wipes off glass easy —

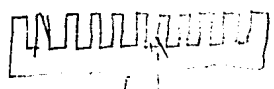
Used 7 cells 4 hours current on.
20 mins lost. Therm started 85 —
only once did it get to 124 —

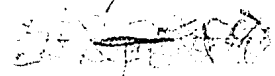
Think we can prevent polarization of the $1\frac{1}{2}$" Electrode in Calf [illegible] Nickel dose covering [illegible] by making it thin —

or



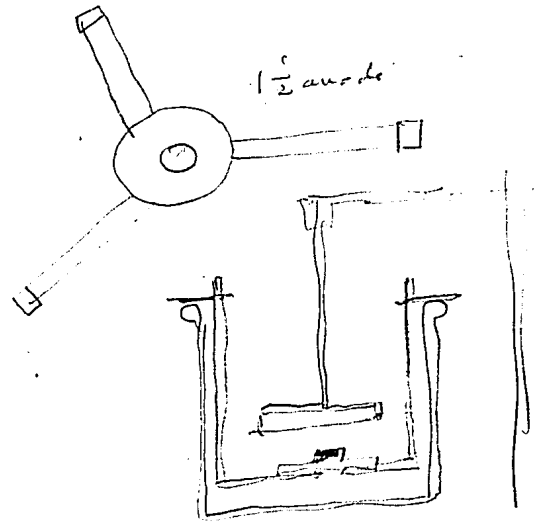






Testing our new plating rig
Nickel faced master

on 1028 — 1 amp 10 min — $2\frac{1}{2}$"



Ok - more cu in center as expected at $2\frac{1}{2}$ should be $3\frac{1}{2}$ @ 4 to get even -

Grimes has a Silvered Submarine with ring around to stop plating heavy on edges

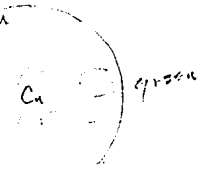
We will Coat it in New Reg 1 amp 20 minutes, before putting in Reg Copper (with) Crock 22 Rev

3 Lamps across

On 1046 - off 1106 -

1109

Spotty -



Shows what a poor thing this silver Coating is - its no -

On at 1109 for 20 min at 20 amp off ~~1130~~

one min off anode got oxide on it

Went down to 1 amp -

2 min off again to clean anode

1 min off again - At 1125 Reduced to 1 amp - off 1130 -

1/2 covered spotty

We put in Reg bath 3 amp -

We now put in a golded sub marine NO7 -

1 amp 20 min - cleaning off surface of liquid by paper to get rid of scum -

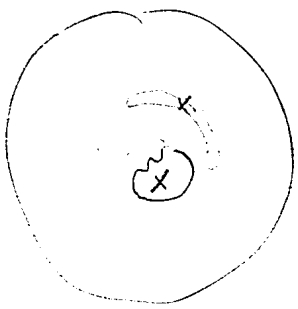
Distance from anode 2"

~~The~~ On 1143. off 1203,

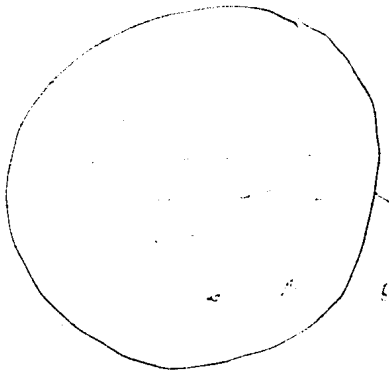
The difference between the beautiful Coated one the other day + this with gold wire a new rig so that this had Cells got down a hard to put 7 new ones in in exchange for the others and that we used Glacial Phos Acid in Vac so we get fine results without it we are going to discard its used - gold on this not bright + near label is dark ring 1/4 to 3/8 wide -

On 1205 for 20 min more

See remarks next page On 1226 1 amp



X not coated
but it in
Reg tank
3 clamp



No scallops
bright spots

High resistance gold –

off 1247 –

gradually lower

On 1247, off 108

215 nearly filled except below 2 [illegible] [illegible]

3/4 (lower) the black ring reformed. Lower & gold gradually broken here we put on 1 amp & let her go see if she will lower –

No 4 Moore

101 Varnish - 1011 wood -

1 under Vac 3 min
2 in contact 2 min
3 up to 60 lbs 3 min
4 The 500 lbs 1 min -
5 Cooled off both sides 15 min
Took Vac off when Turned on water

During Cooling down pressure gradually went down to 150 lbs,

Louis Ott has made 21 different kinds of fusible metal. We have pressed them on a Master. The results are very promising. Some are amorphous, it will require at 80° Fahr 1500 lbs pressure — will try effect of rise of temp —

We will make a present from a Master Mould then plate it 40/1000 with Copper & melt out the fusible metal in Oil or Lard according to MP — Can plate this on a little & then fill up with Copper

Possibly the back of a fusible metal should be blacked with Copper or Nickel & pressed then it could be silver or gold plated to preserve the shining surface —

2" dia fus – 300 at start rise fully in Cu bath at 6.48 am –
½ amp –
at 710 put on an ampere –

* Made 2 Sn 2 Pb 1 Bi big plate.

Tried it in press at 600, with free heat of steam pressure in 5 minutes blistered –

Recast the dive in press with steam heat, pressed it on Lubricating of Cocoanut Oil only tops of leaves shown around Edges – We now Take it up steam 9 ozs at 2200 lbs & 60 pressure

* Has alloy coats Copper in Electroplating bath.

We shall probably have to Coat surface of second on this with gold in Vacuum or Nickel in bath Electrolyzing which it will not reduce transferring the Nickelled piece quickly to Copper bath to prevent oxidation then will Cause Copper to stick to the Nickel & be integral therewith –

With the new metal it decomposes acid Copper solutions but not the Copper Potassium Cyanide solution in this it plates very slow & perfect & transferred it to the regular Copper bath & plated it thicker but the Cyanide Copper deposit adhered so perfectly that not the slightest piece could be detached but was however very thin—

On the other part of ingot old Copper was on & put the whole in dish & melted out the metal but found had to say that the metal amalgamated with the plated Copper so the planes melting out cannot be used

I will probably have to be plated in vac with gold or put in a Reg Copper bath

and quickly connected to Current, it can then be detached mechanically —

I tried the metal in German Nickel solution it plated 7/10 of a thousand & started to peel at Edges (e) Turn up — The nickel was easily detached so here is a way that probably can be used after preparing the record on the just covered with Nickel equal to the amount we put on Wax & transferred West to the Copper bath & plated the 40/1000 thick & detached. I think the Ni will stick to the plated Copper

The nickel that I pulled off showed a very mirror like surface —

[illegible] found that the alloy is not homogeneous parts settle out hence it cannot be used until we get a better one

Tried pressing a number of [illegible] [illegible] 224 by Thorn – heat 5 min press 500 lbs & immediately cool & keep pressure upon perfect & smooth but could get [illegible] quite yellow part [illegible] [illegible] [illegible] [illegible]

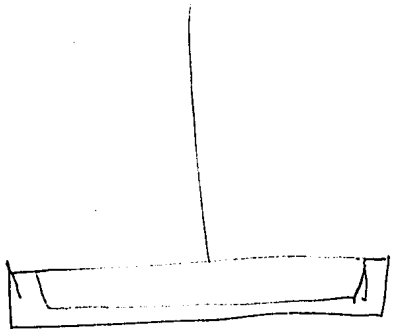
When took out [illegible] the product warped & pressed & dead cold 1500 lbs [illegible] sign of melting black & not [illegible] & moved OK no sign of [illegible] [illegible] [illegible] [illegible]

Transverse and thermals defective, have one too [illegible] a dent

its full of dirt [illegible]
[illegible]
before

[illegible]

[illegible] down

its only on one section of [illegible]
Rosalie [illegible]
on [illegible] along [illegible]
[illegible] [illegible]
bubbles in [illegible] come [illegible]
[illegible] or gas [illegible]
were released burst out [illegible]
the [illegible]
also a [illegible] second
which gave my boy Rosalie
found that something in it an
[illegible] popped out like
popcorn [illegible]
[illegible]
[illegible] with my [illegible]
Neil – There is an
[illegible] very [illegible]
that [illegible] – the very shiny

Took a No 7 transfer peel plate
on peel in press used vac put no
pressure on - 6 min at 5.LBs steam
pressure; 225° chilled it
blank never bond my pressure -
On removing it all the big
yellow transparent spots swelled
way up showing it was air
trapped in cementing transfer on
the blank was thick with
pimples mostly at outer edge
& near center - there were several
groups where the row of pimples
looked recent - these pimples are
unmistakeably air in the varnish
put in by the brush & cure the
cause of crackle -